

dition of the plant and hence does not furnish an accurate index of growth. Cloudiness and other factors cause variations in the duration and intensity of sunshine, which are only partially reflected by the air temperature, while the plant responds more perfectly.

MEASURING THE TEMPERATURE OF LEAVES.

Mrs. Edith B. Shreve has devised very sensitive electrical apparatus for measuring the surface temperature of leaves and has been making measurements in the desert and mountains near Tucson, Ariz., and the Santa

Lucia Mountains in California. She reports that the most outstanding result of these measurements is the rapidity with which the surface temperature of a leaf growing in the open may fluctuate. Changes of from 1 to 3° C. are observed within 20 to 60 seconds. If a moderately strong wind is blowing the change may amount to 5° in 30 seconds. [Momentary changes in the temperature of the passing air are without doubt in part the cause of these fluctuations.]—*Reprinted from Scientific American, Apr. 12, 1919, p. 365.*

ALFALFA GROWING IN WESTERN SOUTH DAKOTA.

By HARLEY N. JOHNSON.

[Dated: Weather Bureau, Rapid City, S. Dak., April, 1919.]

SYNOPSIS.—The climate of western South Dakota is especially favorable for raising alfalfa, as 73 per cent of the annual rainfall of 15 to 20 inches is received during the period from April 1 to September 30, the percentage of sunshine is high, the rate of evaporation is comparatively low, and moderate temperatures usually prevail during the growing season. The soil is deep and rich and retains moisture well. Alfalfa needs considerable moisture while growing, but fair weather while the hay crop is being harvested.

Alfalfa seed is usually produced from the second crop when conditions are such as to retard the maturing of the first hay crop. Alfalfa seed is produced in paying quantities in South Dakota only when there is a comparative shortage in the moisture supply, hence the weather conditions determine whether the second crop shall be cut for hay or left for seed. If there is considerable rainfall, the second crop is usually cut for hay, and a third crop is frequently possible.

As alfalfa hay is damaged by rain when curing, special weather forecasts are issued and widely distributed during harvest. The growing season is usually of sufficient length to mature seed from the second crop, but if it is too dry after the first crop has been harvested, and the growth of the second crop checked, there is danger of frost injury to seed in the early fall. A frost-warning service is therefore maintained and is widely utilized by seed growers.—*J. W. S.*

There are 24 counties in South Dakota west of the Missouri River, comprising 26,266,895 acres, of which, roughly 5 per cent is devoted to the raising of alfalfa. The usual yield is from two to three crops of hay per year, or approximately 3 to 5 tons per acre. Western South Dakota has been producing alfalfa for the past 38 years, the first seed of record being brought from Utah in 1881, and it is now successfully grown in every county and has become the great staple forage crop.

The experience of alfalfa growers, covering a period of a great many years, shows that a semi-arid region is particularly adapted to the raising of alfalfa. From 15 to 20 inches of annual rainfall is usually considered necessary for successful farming operations, without irrigation. However, there are several modifying factors to be taken into consideration in connection with the raising of alfalfa in a region of light rainfall, viz, the seasonal distribution of rainfall (73 per cent of the annual, falls from April to September in western South Dakota); the rate of evaporation; amount of sunshine; temperature; and the qualities of the soil for retaining moisture. The deep rich soil of the farming sections of western South Dakota, the prevalent warm sunshiny weather, and the favorable distribution of precipitation evidently produce the proper combination necessary for its best growth. There is practically no land in western South Dakota, that is susceptible of cultivation, that will not produce alfalfa, and probably 95 per cent of the production is grown without irrigation, the practice of irrigation being limited to a few valleys where the crop is grown almost exclusively for hay. (See fig. 1.)

Three varieties are most extensively grown, viz: Common or mixed varieties, Grim, and Turkestan.

The first step in the process of raising alfalfa is the preparation of the seed bed, which is of vital importance. The ground should be plowed and harrowed, or double disked, then given time (from a month to six weeks) to settle thoroughly before planting the seed. The planting is usually done in the spring, with a drill having a special feed for alfalfa, and is set to sow from 10 to 12 pounds of seed per acre, and to cover the seed from 1 to 1½ inches deep. Just before planting the top crust should be loosened and pulverized by light harrowing, as this will insure a fine soil on the surface for seeding and a firmer soil below for the embedding of of the tap root, which immediately strikes downward after germination of the seed. However, there are many fields of alfalfa where the seed was sown broadcast on unbroken sod and disked in. This method is not advisable as experience has shown that the stand will die out in a few years, although the first two or three years crop may be exceptionally good.

The alfalfa plant is more or less subject to winter-killing, a situation that is practically unpreventable, except where irrigation is practiced. The chief causes of winter killing in the Middle West are: Excessively dry weather in the late fall and winter, and alternate freezing and thawing of the soil. From the first cause the injury is frequently of considerable consequence, as occasionally the fall precipitation is insufficient to supply the soil with moisture necessary to keep the plant alive, and for evaporation. However, this feature is overcome to some extent by an average snowfall of 13.5 inches (Rapid City record) during the months of December, January, and February. The snow blanket affords a protection from the cold and wind, thus eliminating the winter-killing that would otherwise result in an open dry winter with no snow covering. From the second cause the injury is probably greater. The damage from this cause is increased when an excessive amount of precipitation occurs in the late fall. When the soil is saturated with water the alternate freezing and thawing on days when the ground is bare may prove fatal to the plant, due to the fact that the sap rises into the branches on warm days, then freezes when the temperature falls, thus causing an expansion or rupture of the cells of the plant. The average number of freezing and thawing days, with no snow covering, for the three winter months is as follows: December, 10; January, 10; February, 9.

Almost without exception the first crop of alfalfa is utilized for hay. If the season is early and the first crop of hay is matured and cut before June 10, the prospects for two more hay crops are good, but if the first



FIG. 1.—Alfalfa in rows, Rapid City, S. Dak.

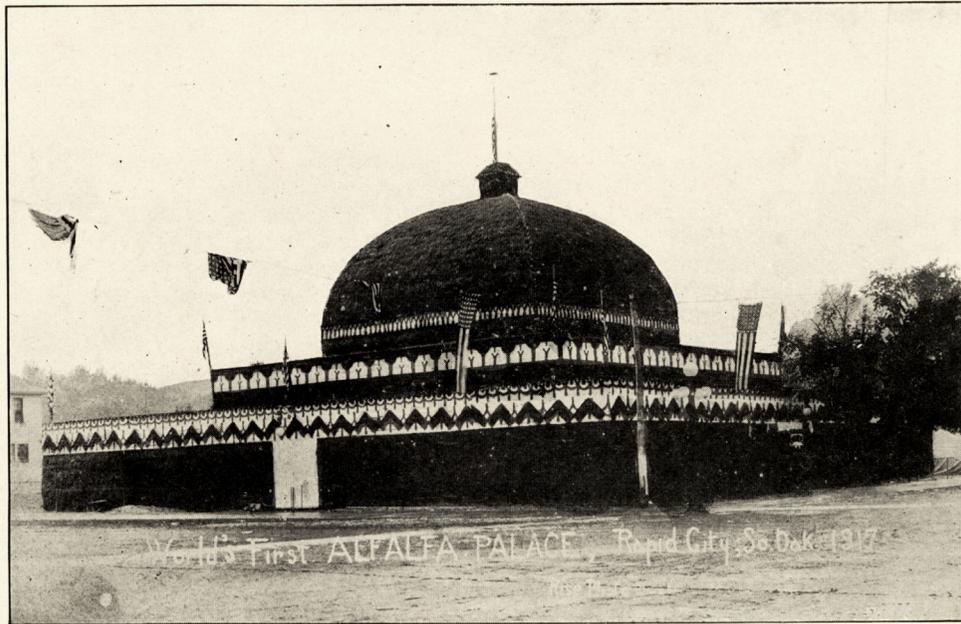
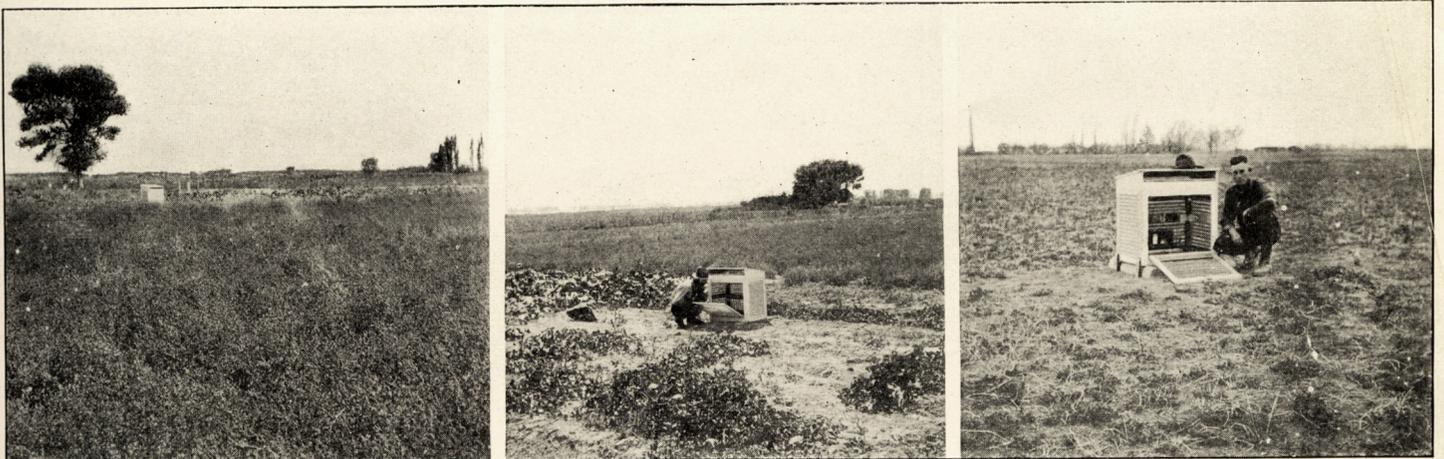


FIG. 2.



J. C. Alter.

FIGS. 1-3.—Special alfalfa-seed region meteorological station, Deseret, Utah, in 1916, 1917, and 1919.

crop does not mature early the second is left standing to produce seed. The weather conditions determine whether or not the second crop should be utilized for hay or left for a seed crop. It requires from 30 to 40 days under favorable weather conditions to mature a hay crop. The haying season with growers of extensive acreage is practically continuous from the beginning of the first cutting until frost in the fall, and the method of handling by means of improved implements is quite generally employed. The harvesting of alfalfa hay is often seriously interrupted by showers or rainy weather. Much difficulty is experienced in this connection, as alfalfa hay is easily injured by rain, and every effort is made to cure the crop if possible without getting it wet. While the feeding value of hay that has received only a light rain is not materially lessened, it is, nevertheless, discolored and does not sell well on the market. Oftentimes it is impossible to cure the hay without injury from rain, as it requires from 36 to 48 hours of drying weather for the hay to cure, while the average number of rainy days, 0.01 inch or more, during the harvesting season is as follows: June, 13; July, 10; August, 9; September, 6.

One of the essential features of handling the hay is to prevent the loss of the leaves—the most valuable part of the plant—which will occur if left in the field too long after cutting, especially if the hay has been rained on.

Special weather forecasts are issued by the Weather Bureau in the interests of the alfalfa growers of western South Dakota during the haying season, which enables them to determine how much hay can be cut and cured before rain is likely to occur. Arrangements are in effect whereby the forecasts for an extended period of fair or rainy weather are distributed by telephone throughout the alfalfa growing sections. As the great majority of growers have telephones in their homes, the information reaches them without delay. Upon receipt of the forecast for continued fair weather the grower immediately starts cutting and continues until the advent of unfavorable weather. The information and the advantages thus gained by the forecasts of the Weather Bureau are of great value to the grower, and the service as maintained is highly appreciated in this section.

On the great "bench" lands above the creeks is grown, without irrigation, the greater portion of the alfalfa seed raised in western South Dakota. The yield runs from 3 to 8 bushels per acre, and the buyers from the large seed houses come to western South Dakota to buy seed for commercial purposes. The seed is eagerly sought on the market and commands a price considerably above the average on account of its superior qualities. In many cases the returns from the production of the clear, golden colored, acclimated seed, which has demonstrated its superior ability to withstand adverse weather conditions, has more than paid for the land on which it was produced. Alfalfa seed is produced in paying quantities only when there is a comparative shortage in the moisture supply. Heavy rains during the blooming period are injurious to the seed crop, and

for the finest quality of seed the weather should be dry from blooming time until after the harvesting of the seed. Alfalfa seed development requires a hot, dry season, and in order that the crop may mature during such periods, the second crop is generally utilized for the growing of seed. If after the first cutting of hay precipitation occurs in sufficient quantities to give the second crop a good start very little moisture is required thereafter, although the time necessary to mature a seed crop is about twice that required for a hay crop, or from 70 to 90 days. Should the weather be unusually dry in June and the second crop delayed in getting a start, there is danger of injury to the seed by frost in the early fall. However, the growing season is usually of sufficient length to permit the maturing of the seed crop.

A frost-warning service, under the supervision of the district forecaster at Chicago, Ill., is maintained by the Weather Bureau in the interests of the seed growers. Upon receipt of frost or low temperature warnings the local office immediately takes action to make a thorough distribution of the warnings by telephone. The arrangements for distribution are practically the same as for the fair weather forecasts referred to above. The distribution is made over almost every rural telephone line in this section of the State. A special ring is given for "weather," whereupon some member of the grower's family copies the report, and action is then taken accordingly. The protection of the seed crop from frost is sometimes a difficult problem. If the crop is late and the frost comes early in the autumn, the seed will be too green to harvest, even though the grower is warned of coming frost. However, this difficulty is overcome to some extent by some of the more progressive growers, who have made a study of, and experimented with, this feature of alfalfa raising. When the frost warnings are received from the Weather Bureau, the grower immediately cuts his green seed crop with a self binder and puts the bundles in narrow ricks two bundles wide, with the heads inside and the butts outside. The moisture escapes through the butts and the seed dries and thrashes out a bright natural color, very much the same as if left to ripen in the field. The narrow rick prevents heating.

To insure the greatest quantity of good seed the alfalfa is harvested when from one-half to three-fourths of the pods have turned brown. Many inexperienced growers cut their seed too green.

Various methods of harvesting are employed, the mowing machine, self-rake reaper, self-binder, and header are used, special care being taken to lose as little seed as possible by shattering while handling. A thin stand is considered best for the production of seed, and the practice of growing alfalfa in rows about 3 feet apart is recognized as advisable, as this affords a means by which the plants can be cultivated and thinned, if necessary.

The importance of the alfalfa seed crop in this section is of considerable consequence, as is evidenced by the fact that the supply is insufficient to meet the demands, although several trainloads of seed are marketed from western South Dakota each good seed year.